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Consumer Preferences for High-Tech Product Forms: Converged or Separate? Evolution of Technology & Reversal of Preferences

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Abstract

With the surging popularity and growing availability of convergence products (e.g., camera phones, all-in-one PDAs) in high-tech product categories, consumers now face another dilemma in their purchase consideration: which product form—converged, stand-alone, or both? This study sets out to investigate pattern(s) of consumer preferences for product form along the evolution of technology trajectories. In two experiments, we find that, at low levels of technological performance, consumers show an overwhelming preference for the converged product form over the dedicated counterpart; whereas, at a higher technological performance level, the pattern of preferences is reversed. Furthermore, we observe that a preannouncement of even higher technology can shift consumer preference from one product form to another. We forward dual (product form-specific) performance reservation values as a key mechanism underlying the observed preference structure. Other issues explored include complement vs. substitute intercategory dynamics. Finally, managerial implications and directions for future research are also discussed.

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Introduction

In recent years, the pervasiveness of techno-culture is becoming very apparent in the mainstream as consumers increasingly look to high-tech products as lifestyle solutions—at work as well as for play. According to the 2004 U.S. Consumer Electronic Association's Ownership Survey, the household penetration rate for PCs and notebooks has reached 71%, nearly 2 out of 3 adults carry mobile phones, and digital camera ownership has jumped to 39% and expected to climb higher. With many more technological products (e.g., PDA, MP3-player, media player) in line to join the ranks of consumer essentials, the dilemma, however, soon becomes evident. That is, the sheer number of high-tech products a modern-day consumer must wield is fast becoming cumbersome, and for some, already reaching less than manageable levels.

To this end, product bundling is receiving a renewed, industry-wide attention as a seemingly logical product strategy (*The Economist*, March 12, 2005). Referred to as *product* or *digital convergence*, manufacturers are configuring two (or more) of digital-platform technology into an integrated form (e.g., mobile phone and digital camera into a camera phone), and many variations are already appearing in the marketplace (e.g., mobile phone/MP3-player; PDA/digital camera; game console/mobile phone). While product convergence is fast becoming a popular choice option for consumers, the demand-side impact of convergence product strategy remains relatively unexplored to date. In particular, how does the introduction of product convergence affect the consumer preference for the corresponding non-converged (or "dedicated") product counterparts? Moreover in a related issue, what are the boundary conditions for the product

convergence and dedicated products—to act as complements or substitutes? To better understand the underlying intercategory dynamics between converged and dedicated products, this study sets out to explore consumer preferences among the two product categories along key points in technology trajectories.

Insert Figure 1 about here

As illustrated in Figure 1, manufacturers generally introduce converged products on a lower technology trajectory relative to the dedicated product form (e.g., camera phones first appeared on the market with picture resolution around a mere 100,000-pixel count at a time when mass-market consumer digital cameras were already offering 1 to 2 megapixel resolution). As technology transfer from dedicated to converged forms continues to accelerate over time, the two technology trajectories may eventually approach convergent paths (e.g., at the present, many models of camera phones and dedicated digital cameras both offer 5 megapixel resolution). Finally, both technology trajectories may surpass the performance requirement demanded or needed by majority of consumers (e.g., future camera phones and dedicated digital cameras both may offer 9 megapixel resolution)—as exemplified by today's PCs offering overperformance in clockspeed (Markoff 2002). In the process of tracing the trajectories, we also explore the concept of *performance reservation value*—a notion that there is a minimum level of given technology's performance considered acceptable by consumers. Specifically, whether such a

baseline serves as a reference in shaping consumer preference for product form—and perhaps in turn, technology trajectories—warrants a closer inspection.

In sum, the purpose of this study is two-fold: (1) conceptually, to uncover consumers decision-making process in the intercategory context over time; and (2) managerially, to provide new insights into product-line portfolio decisions with dedicated/converged products. To this end, through a series of experiments, we assess (i) consumers' choice patterns between converged and dedicated product forms, (ii) consumer's purchase intentions of products on higher technology trajectory, and (iii) the impact of future-technology pre-announcement on consumer preference with respect to presently available technology and product forms. Theoretical and managerial implications are discussed.

Convergence as Product Bundling: Definition and Background

As product convergence has its conceptual grounding in the bundling literature, we first revisit the notion of product bundling for insights and clarifications. In a recent review article, Stremersch and Tellis (2002) stress the need for a proper understanding of bundling definitions, as the terms *product-* and *price-bundling* have often been used interchangeably, though erroneously, in the same context. The distinction lies in that price bundling is selling two or more individual products in a package at some price discount compared to buying each of the items separately. Furthermore, price bundling does not physically integrate products, hence no added value is created in the process. In essence, price bundling is a pricing and a promotional tool, which necessitates discounts to entice some consumers in the product package that they may not buy otherwise.

In contrast, product bundling decision is made at the manufacturer's level—as the process entails integration of two or more product functions into a single product form, typically for sake of consumer convenience. Despite its intuitive appeal, product bundling has been met with limited success in the past. For instance, video phone that was supposed to revolutionize business and consumer communication ended up as a costly failure for AT&T (Schnaars and Wymbs 2004), and the appeal of multifunction machines (printer, copier, scanner, and fax functions) never went beyond the niche segment of small-office/home-office consumers (Kim, Han, and Srivastava 2002).

The common denominator for the lackluster appeal for past product bundling attempts was that consumers typically found *all-in-one* products to be more-or-less "underperforming *octopus peripherals*" (Crawford 2004). When posed as a trade-off between performance and convenience, functional integration apparently failed to provide a good value proposition to the market at large. Nonetheless, product bundling showed some signs of promise when represented as less of a "zero-sum" proposition. For instance, integrated stereo-receiver is one such a case which manages to offer the convenience of tuner, pre-amp, and amplifier in a consolidated form without perceptible loss in sonic integrity to all but a handful of audiophiles. Nonetheless, with successful cases being in the minority, product convergence has remained largely a fringe product-strategy—that is, until recently.

Key developments in technology—especially in the areas of component miniaturization and digital processors—have opened up the market for a new wave of product bundling (Chan 2004). In fact, convergence products represent one of the fastest growing product categories in consumer technology today: e.g., camera phones have surpassed the sales level of stand-alone digital cameras since there first introduction in 2001 (Reinhardt, Tashiro, and Elgin 2004).

Although the surge in product convergence may alter the consumer technology landscape, the extant research on product bundling/convergence remains rather limited to date.

From the demand-side perspective, there are a number of issues of significant interest to both scholars and practitioners alike. Specifically, do consumers acquire converged products as a substitute or complement to dedicated product forms? Furthermore, does the order of consumer's product acquisition (e.g., camera phone first or digital camera first) make a difference? In other words, would a consumer purchasing a camera phone as the first product be less, or perhaps equally, or even more likely to purchase a dedicated digital camera at a later point in time vis-à-vis someone purchasing stand-along digital camera first? Yet unaddressed is also the issue of performance threshold: e.g., for a given functional feature, whether consumers apply a common performance standards across product forms, or differential levels contingent upon the product form, remains to be seen. In the following section, we piecemeal together pertinent theories from diverse literature to gather insights into the posed questions.

Consumer Preference for Product Form along Technology Trajectory

As the aim of this study is to uncover the consumer preferences for product forms along their technology trajectories, we identify three distinct phases in the intercategory dynamics and investigate the preference structure accordingly.

Phase 1: Introduction of Converged Product on a Relatively Lower Technology Trajectory

As a general industry practice, converged products initially emerge on a lower technology trajectory relative to the state-of-the-art. Typically, at this stage, manufacturers are

generally constrained by either technical and/or considerations in wholly transferring/adapting to the converged product platform. For instance, typical camera phones in 2003 were equipped with 300,000 to 400,000 pixels (e.g., VGA-quality, grainy picture resolution), whereas, many mass-market consumer digital cameras already had 2 megapixel (that is, higher picture resolution that can produce good-quality 4 x 6 inch prints). With the introduction of the converged product, consumers in the lower end of the technology market will have to now face an interesting intercategory choice situation: e.g., which product option he/she would prefer, *ceteris paribus*:

Option A: Camera phone with 1-mega pixel resolution

Option B: Digital camera with 1-mega pixel resolution and a mobile phone of similar quality as in Option A

Surprisingly to date, there are no empirical findings available with respect to consumer preferences for product forms; to this end, we look to diverse domain for insights. The following theories shed some light on the likely dominance of one option vs. the other.

Performance Reservation Value: Single or Dual. The notion of reservation value for a product attribute has long been the associated with consumer decision-making research (i.e., Arora, Allenby, and Ginter 1998; Lambert 1978) and innovation literature (i.e., Adner and Levinthal 2001). The focus, however, has largely been in either a single-category setting, or limited to pricing issues. One notable exception is a recent conceptual piece by Shocker, Bayus, and Kim (2004), where the authors speculate that integration of separate categories may potentially alter the product reservations values. Shocker, Bayus, and Kim (2004), however, stop short of venturing a guess on the direction of change.

Nonetheless, anecdotal evidence seems to indicate a downward adjustment on reservation values for the converged product—as inferred from the category-sales figures: in the year 2003, despite camera phones outselling stand-alone digital cameras at a rate of 2-to-1, the average resolution of the camera phones were substantially below that of stand-alone digital cameras (Gleeson 2003). In other words, with dual performance reservation values—where such a value for converged form is lower than that of dedicated form—the likelihood of consumers rejecting the dedicated product form would be higher when the considered technology level is relatively low for both product forms.

Mental Accounting. A related reasoning put forth is the mental accounting explanation. According to Thaler (1985), when consumers encounter either mixed gains or losses, integrating the components seem less painful than framing them separately—due to the asymmetric S-shaped value function where the slope is flatter relative to losses. The implication is, regardless of whether consumers apply single or dual reservation values for the intercategory context decision-making, the integrated option (e.g., camera phone) will dominate the segregated option (e.g., digital camera and mobile phone) at low levels of technological performance.

Bundling as Transitional New Technology Introduction Strategy. Eppen, Hanson, and Martin (1991) posit that, when potential customers do not have experience with the new product, bundling is an effective strategy in the introducing the new technology with other components as the offering is perceived as a simplified solution to consumers. However, Eppen, Hanson, and Martin (1991) proceed to qualify that remark with limiting its efficacy to the early stages of technology. The rationale is that, as consumers become more knowledgeable of the technology, they are more likely to pick and choose their own configurations—thereby, there is no further need for an integrated solution. In a similar line of reasoning, at low levels of technology,

consumers are likely to prefer converged product (Option A) over dedicated product (Option B) forms.

New/Obsolete Paradox. Mick and Fournier (1998) defined a typology of paradoxes that consumers experience in today's technology-based environment. One such example is the *new/obsolete paradox*, which illustrates the irony of a newly-purchased technology product practically becoming obsolete instantaneously. To cope with such a dilemma, Mick and Fournier (1998) report that consumers put into practice a buying heuristic of choosing "the latest, cutting-edge model." Therefore, in our choice context, Option A would be likely chosen as it represents more of the "latest, cutting-edge model" than Option B (consisting of a low-end stand-alone digital camera and a mobile phone).

In sum, we have identified psychological processes and heuristics that would point to Option A dominating Option B in a choice context. Accordingly, we formally state the hypothesis on the consumer preference in Phase I:

> **H1**: In the intercategory choice context between converged product form vs. parallel dedicated product forms, more consumers will prefer the converged product form at low levels of technological performance of a common given feature.

Phase II: Converged Product approaching Dedicated Product Technology Trajectory

In the evolution of technological trajectories, a sustained growth of convergence category apparently accelerates the technology transfer from the dedicated product category. This is the very situation we are witnessing in the camera phone category today: for instance, the resolution of many camera phones are reaching upwards of 5-mega pixel count—the same standard

resolution available in many of the stand-alone digital cameras sold in non-professional, consumer markets. At such levels, camera phones can produce large-sized images for printing and displaying on external devices. If the technological performance gap between the converged and dedicated products are starting to blur in the latter phases of the technology trajectory (Phase II), then would there be still be a systematic preference for a particular product form, *ceteris paribus*, in the following choice situation?

Option C: Camera phone with 5-mega pixel resolution

Option D: Digital camera with 5-mega pixel resolution and a mobile phone of similar quality as in Option C

If so, would there be a similar preference pattern as in Phase I, or a reversal of preferences? Again, we search for relevant psychological processes and heuristics for some insights into consumer preferences for product forms.

Adding a New Feature Innovation. Consumers have been known to make inferences in many social and consumption contexts, often based on limited information (Broniarczyk and Alba 1994; Huber and McCann 1982). In particular, Mukerjee and Hoyer (2001) have found that consumers make inferences about learning-cost when a new feature is added to a high-complexity product (citing PC and programmable camera as such examples). In these contexts, they report that consumers tend to focus their attention especially on the negative aspects—e.g., learning costs—which led to lower product evaluation. Accordingly, at a higher technological level, convergence product may potentially be perceived as a high-complexity product with a new added feature. In such a case, lower product evaluations will likely result for Option C, hence, Option D having a higher likelihood of being selected over Option C.

Bundling as Imposition of Firm's Preferences on the Users. While Eppen, Hanson, and Martin (1991) promoted bundling as an important technology launch/introduction strategy, they emphasized it only as a *transitional* strategy. In later stages, the caveat is that bundling may become an "imposition of firm's preferences on the users" as users learn to choose on the component basis to meet their own needs (Eppen, Hanson, and Martin 1991). Citing Macintosh computer as a heavily-bundled, closed system, its key limitation was the lack of system's flexibility. Analogously, the converged product form may be perceived as an inflexible system at higher levels of technology performance; hence, a greater likelihood of selecting Option D over Option C.

Dilution Effect. Nisbett, Zukier, and Lemly (1981) have shown that adding either nondiagnostic or supposedly irrelevant information may dilute the impact of diagnostic information. For instance, people moderated the GPA predictions of students when given irrelevant information as, e.g., the number of plants students kept, the number of times students played tennis per week. Compared to Option D, Option C may be more prone to the dilution effect if integrated mobile phone function washes out the evaluation of 5-mega pixel digital camera function in the camera phone category. In essence, the old adage of "jack-of-all-trades, master-of-none" may become rather salient with convergence products especially at high technology levels.

Performance Reservation Value. The dilution effect explanation is also consistent with the product-form dependent, dual reservation value hypothesis. In the first place, the reason why dual reservation values may arise may be a reflection of consumers' relatively lower expectation/evaluation of the converged product form compared to the dedicated counterpart.

Hence, at a relatively high level of technology performance, the dedicated form would likely to be chosen over the converged option, *ceteris paribus*.

A review of the literature has yielded several processes and rationale applicable to intercategory decision-making, and we find likely support for consumers preferring dedicated vis-à-vis converged product form at relatively higher levels of technological performance. In fact, this prediction is a reversal of consumer preferences for product form at different level of technological levels—in Phase II (preference for dedicated product form at high levels) as compared to Phase I (preference for converged product form at low levels). Hence, stated formally:

> **H2**: In the intercategory choice context between converged product form vs. parallel dedicated product forms, more consumers will prefer the dedicated product form at high levels of technological performance of a common given feature.

Converged and Dedicated Product Forms: Substitutes or Complements?

For manufacturers, product-line management decisions has always been a compelling balancing act, and managing both converged and dedicated products in the firm's line-up should be no exception. Specifically, converged products have traditionally been considered as substitutes for the dedicated counterparts (i.e., multifunction machine vs. fax, copier, telephone, scanner; integrated stereo receiver vs. amplifier, pre-amp, tuner). The ownership figures, however, show significant number of consumers possessing both product forms in the case of camera phones vs. digital cameras (*Softpedia News* 2005). Moreover, past intercategory research

(e.g., Kim, Chang, and Shocker 2000) has shown that even seemingly more directly substitutable products are complements at certain stages of technology trajectory. For instance, pagers and the earlier generations of mobile phones initially started-out in synergistic trajectories until the later generations of mobile phones ended up displacing the former outright in the advanced periods of technology evolution (Kim, Chang, and Shocker 2000).

Taking a closer look at the converged vs. dedicated products along the technological trajectory, e.g., there are four possible scenarios for subsequent purchase at a given higher technology level (e.g., at 5-mega pixel level) for the owner of 1-mega pixel camera phone and likewise for the owner of 1-mega pixel digital camera—as shown by the arrows in Figure 2. For the owner of 1-mega pixel camera phone, he/she can purchase in the near future (i) a 5-mega pixel digital camera; (ii) a 5-mega pixel camera phone; (iii) both products; or (iv) none of the products. Similarly, the owner of a 1-mega pixel digital camera has the same four choices.

Insert Figure 2 about here

The ideal situation for the manufacturer would be Scenario (iii). However, based purely on preference patterns as stipulated by hypotheses 1 and 2, our prediction is that the owner of 1-mega pixel camera phone is likely to purchase a 5-mega pixel dedicated digital camera—Scenario (i). This is in line with Eppen, Hanson, and Martin (1991)'s logic of weaning the consumers with primer integrated package, and in due time, consumer prefers to choose separate components to satisfy his/her needs at higher technology levels.

With respect to 1-mega pixel dedicated digital camera owner, we do not have strong priors, but based on Hypothesis 2, we will also predict Scenario (i) as the likely category purchase along the higher technological trajectory. Hence, this would be simply a case in direct technological substitution of multigenerational product (e.g., Fisher and Pry 1978; Norton and Bass 1987; Mahajan and Muller 1996). In sum, we postulate that:

> **H3a**: For owners of converged product with low technological performance, there is a complementary dynamics with respect to dedicated products with high technological performance as a subsequent future acquisition.

> **H3b**: For owners of dedicated product with low technological performance, there is a substitution dynamics with respect to dedicated products with high technological performance as a subsequent future acquisition.

In summarizing H1 – H3, consumers are likely to prefer converged (dedicated) product form at low (high) technology levels, and that there is likely to be asymmetry in the complement vs. substitute relationship in subsequent acquisition—pending order of initial category acquisition (that is, complement—if converged form first; substitute—if dedicated form first).

STUDY 1

Method

Fifty-one undergraduate business students participated in this experiment in exchange for a course credit. The participants received questionnaires containing information about two options of product forms (See Appendix 1 for a sample questionnaire). The first option was a

purchase consisting of two separate products: a mobile phone and a digital camera. The second option was a purchase of a converged product: a camera phone that combines functions of a mobile phone and a digital camera in a single physical unit. The order of product-form options was counterbalanced. The subjects' task was to indicate which of the two product forms they would choose.

The between-subject experimental design consisted of a low-performance condition and a high-performance condition. The dependent variable was product-form choice between the two options. In the low-performance condition, the 1-megapixel resolution level was given in both and converged and dedicated product-form options. In the high-performance condition, it was set at 5-megapixel level. The 1-megapixel level represented both the higher-end of the camera phones and the lower-end of digital cameras at the time of the data collection in 2004 year's end; analogously, the 5-megapixel level was selected to reflect the high-end of technological standards. For instance, "the sweet spot for mass sales of digital cameras…last year…was 3 to 4 megapixels, and this year it will likely rise again" (Huglett 2005). The price level is same for either product form option: e.g., $400 for a 1-megapixel camera phone or $400 for a 1-megapixel digital camera and a mobile phone. This price level was based on a pretest of prices paid by undergraduate students for a mobile phone, rounded to the nearest hundred dollar level of $300, and for the digital camera, the industry average was more-or-less $100 per megapixel.

Measures

At the end of the questionnaire, there were sets of questions that measured the performance reservation value of the picture resolution and the future purchase intention of camera phone and digital camera of higher performance. Seven-point scales, ranging from 1-

megapixel to 7-megapixel, were used to measure the performance reservation values for the digital camera and the camera phone. Specifically, the subjects were asked to indicate the minimum level of megapixel they would consider as acceptable for a digital camera and for a camera phone.

In order to measure the future purchase intention, the subjects were given four questions, two of which asked the subjects indicate how likely they were to purchase a digital camera and a camera phone in the near future assuming that they already owned a digital camera, and two of which asked the subjects indicate how likely they were to purchase a digital camera and a camera phone in the near future assuming that they already owned a camera phone. Subjects in the low-performance condition were asked about their purchase intentions of 5-megapixel digital camera / camera phone assuming that they had already bought 1-megapixel digital camera / camera phone. Subjects in the high-performance condition were asked about their purchase intentions of equivalent-or-higher-megapixel digital camera / camera phone assuming that they had already bought 5-megapixel digital camera / camera phone. The purchase intentions were measured on 5-point scales ranging from 1 (very unlikely) to 5 (very likely).

Results

We predicted in H1 and H2 that more consumers would prefer the converged (dedicated) product form at low (high) levels of technological performance. In support of these hypotheses, subjects were significantly more likely to choose the converged product form in the low-performance level, whereas the exact opposite was true in the high-performance condition (χ^2 = 14.38, p = .0001). Eighty-four percent of the subjects (21 of 25 subjects) chose the converged

product option in the low-performance condition compared with 26.9% (7 of 26 subjects) in the high-performance condition.

Insert Figure 3 about here

We hypothesized that a consumer acquiring a converged product at low technological performance level is likely to consider a dedicated product at a higher technological performance level in a complementary acquisition pattern (H3a), whereas a consumer acquiring a dedicated product at low technological performance level will consider subsequent acquisition at a higher level in the form of another dedicated product—hence following a pattern of pure technological substitution pattern (H3b). Both the hypotheses were supported. Consistent with H3a, when the subjects imagined that they had already bought a 1-megapixel camera phone, the future purchase intention was higher for digital camera (M = 4.04) than for camera phone (M = 2.82; t = 4.22, p = .0001). Also consistent with H3b, when the subjects imagined that they had already bought a 1-megapixel digital camera, the future purchase intention was higher for digital camera (M = 3.86) than for camera phone (M = 2.89; t = 3.58, p = .0001).

The examination of the performance reservation values revealed that, for both the digital camera and for the camera phone, they were indeed shifted upward by higher performance level. For the digital camera, the performance reservation value was higher in the high-performance condition than in the low-performance condition (M =3.54 vs. 2.96; F = 7.621, p = .008). Similarly, the performance reservation value for the camera phone was higher in the high-

performance condition than in the low-performance condition (M =1.96 vs. 1.52; F = 4.831, p = .033).

Further, the notion of 'dual-threshold level' was also supported by our data. The performance reservation value was higher for the digital camera than for the camera phone in both the high-performance condition (M =3.54 vs. 1.96; t = 13.916, p < .001) and the low-performance condition (M =2.96 vs. 1.52; t = 11.066, p < .001).

Table 1

Performance Threshold Values: 1- vs 5- megapixel

Product Form \ Tech Level	**1 megapixel (n = 25)**	**5 megapixel (n = 26)**
Digital Camera	2.96	3.54
Camera Phone	1.52	1.96

The overriding issue now becomes whether the consumer-preference pattern for product form in Phase II will remain stable as the technology trajectory evolves to even higher levels. In the next section, we take a closer look at this very issue.

Phase III: The Evolution and Preannouncement of Future Technology Level

As technology continues to evolve to increasingly higher levels, the level of technology supplied by the manufacturers eventually surpasses the technology level demanded or needed by the consumers in many product categories (Adner and Levinthal 2001; Dhebar 1996; Markoff 2002). For instance, today's processor-chip speed in personal computers or even the level of horsepower in automobiles is generally more than sufficient for the mass-consumer market use

and/or need, and digital camera technology is apparently approaching this point as already 2-3 megapixel technology is providing clear, non-grainy 4 x 6 inch-sized print image (Calabro 2005). The results from Study 1 showed that at 5 megapixel level, which is likely already an overperformance for mass-consumer use, consumers preferred the dedicated product form over the converged counterpart. The question now becomes whether this preference pattern will change when the 5 megapixel level is relatively no longer the high level of technology. For instance, if the state-of-the-art technology is now raised to the 7 megapixel level, such information *per se* may impact the consumer preference for product form in choices involving 5 megapixel technology:

Option E: Camera phone with 5-mega pixel resolution

Option F: Digital camera with 5-mega pixel resolution and a mobile phone of similar quality as in Option E

Specifically, with a higher ceiling in the upper-end of the technology, consumers may apply an anchoring-and-adjustment heuristic to the performance threshold level analogous to 1-megapixel vs. 5-megapixel situation in Study 1. The extent of adjustment, however, will determine the preference pattern for product form: the higher adjustment of the performance reservation value—the greater the likelihood of consumers rejecting the dedicated product form for the converged counter part akin to Phase I. Stated formally,

H4: With a preannouncement on the introduction of technology at a level significantly higher than currently existing highest level, consumer preference will shift from dedicated product form to converged product form relative to the no preannouncement situation.

STUDY 2

Experiment 1 demonstrated that, at the higher performance level (i.e., 5-megapixel), the separate product form is preferred to the converged product form. The purpose of Experiment 2 is to test whether this preference pattern is affected by the preannounced technological advances in the near future.

Method

Seventy-seven undergraduate business students participated in the experiment in exchange for course credit. Similar to Experiment 1, subjects received questionnaires containing information about digital camera and mobile phone in both separate and converged forms, and were asked to indicate which form they would prefer. The between-subject experimental factor consisted of a preannouncement condition and a no-preannouncement condition. In the preannouncement condition, subjects were asked to choose between a 5-megapixel digital camera and a camera phone with 5-megapixel digital camera function, given that 7-megapixel would be introduced in three months. In the no-preannouncement condition, no information about the preannouncement was given; they were simply told to make the choice. Similar to Experiment 1, the questionnaire included two 7-point scales, measuring the performance reservation values for the digital camera and the camera phone, respectively.

Results

Consistent with H4, the preference for the dedicated product form was shifted toward the converged product form when the preannouncement was made. Forty-six percent of the subjects (17 of 37 subjects) chose the separate product form under the preannouncement condition, which

is a reduction compared to seventy percent (28 of 40 subjects) in the no-preannouncement condition ($\chi^2 = 4.59$, p = .03).

Insert Figure 4 about here

The examination of the performance reservation values revealed that, for both the digital camera and for the camera phone, they were shifted upward by the preannouncement of future technological advances. For the digital camera, the performance reservation value was higher in the preannouncement condition than in the no-preannouncement condition ($M = 4.70$ vs. 3.89; $F = 13.455$, $p < .0001$). Similarly, the performance reservation value for the camera phone was higher in the preannouncement condition than in the no-preannouncement condition ($M = 2.50$ vs. 2.03; $F = 4.301$, p = .042).

TABLE 2

Performance Threshold Values: The Impact of Preannouncement

Product Form \ NP vs. P	**No Preannouncement (*n* = 40)**	**Preannouncement (*n* = 37)**
Digital Camera	3.89	4.70
Camera Phone	2.03	2.50

Further, the notion of 'dual threshold level' was again supported. The performance reservation value was higher for the digital camera than for the camera phone in both the

preannouncement condition (4.70 vs. 2.50; $t = 12.49$, $p < .001$) and the no-preannouncement condition (3.89 vs. 2.03; $t = 10.462$, $p < .001$).

Discussion

Despite the escalating importance of convergence movement in the consumer-technology sector, the topic remains yet relatively unexplored in the literature to date. The objective, therefore, was to provide the initial groundwork and motivation for studying the evolutionary intercategory dynamics amongst converged/dedicated product forms. As it is the consumers that ultimately drive the evolutionary course, we approached the issue from the demand-side perspective by investigating the consumer preference patterns for product forms along three phases of technology trajectories. In the process, we found some regularities in consumer preferences. Foremost, consumers prefer converged product forms over dedicated ones when the level of technological performance is relatively low; however, the pattern of preference is reversed at high technological performance levels, and reversal once again with preannouncement of even higher technological performance.

One theoretical account forwarded is a performance reservation value explanation. That is, we found consumers to generally hold dual (form-specific) performance reservation values—with those of the converged form being lower than those of the dedicated form. Consequently, at low technology levels, there is a greater chance of the consumers rejecting the dedicated forms in favor of the converged version due to a higher likelihood of the dedicated ones falling below the reservation values. At higher technology levels, the dual reservation values—as a reflection of consumer's product form expectation/evaluation—are likely to bias preference towards dedicated product form over the convergence product form. While Shocker, Bayus, and Kim

(2004) did speculate on convergence to alter reservation values, our findings provide initial evidence of convergence forms being associated with lower reservation level compared to those of dedicated products.

Furthermore, with a preannouncement of a forthcoming higher-level technology, consumers accordingly adjusted the reservation values higher as well. The result was a shift of preferences towards the converged form at current high technology levels—perhaps, again, attributable to a higher likelihood of the dedicated ones falling below the newly-adjusted set of reservation values. Traditionally, preannoucement literature has focused on new product announcements as signals for preemption against new entry (i.e., Roberston, Eliashberg, and Rymon 1995) or predation against existing competitors (i.e., Bayus, Jain, and Rao 2001; Farrell and Saloner 1986). Our finding introduces an additional dimension to preannouncement's impact—that consumer's preference for product form may be influenced, which is a key factor for product-line management considerations—in addition to the already identified dimensions as purchase timing, brand choice, and generation choice in the extant literature on preannouncement..

A managerial implication and also a caveat are aimed at manufacturers attempting to raise the converged product performance on par with the state-of the-art dedicated product forms (e.g., companies like Samsung are on the forefront of pushing the 5-megapixel camera phones onto today's marketplace). According to the study's findings, manufactures should maintain a tiered structure of technology trajectories—with the dedicated product form always on the higher path. As consumers consistently prefer the state-of-the-art technology in the dedicated product form, the strategy of bringing the converged form on par to the state-of-the-art level with the dedicated products may be an inefficient one—as the cost of development would be relatively

high while the market demands is likely to be relatively low. Moreover, our results show that consumers view converged product of lower technology as a complement to the high performance dedicated product. Therefore, manufacturers are likely to maximize the product-line sales by maintaining the tiered technology trajectories, where the maturing technologies from the dedicated product forms are systematically transferred/adapted to the converged product forms.

Limitations and Future Research

In this study, we have studied the intercategory dynamics at the category level and without consideration of brand effects. As there are firms that are primarily known for digital cameras only (i.e., Canon or Olympus), for mobile phones (i.e., Nokia or Motorola), or for both (i.e., Samsung or Sony), future research can investigate how the breadth of expertise may moderate the consumer preferences for product forms.

Also, we have presented choice tasks limited to the same technology levels of different product forms—though we did assess subjects' purchase intentions for higher-generation products. As several generations of products are often available concurrently in the marketplace, it would be interesting to directly explore consumer preferences for product forms in a multiple-generation setting.

Finally, we have focused on the performance reservation value as a key mechanism driving the consumer preferences for product forms. Future research can explore other potential processes that we have suggested but not investigated: e.g., mental accounting, reactance, dilution effect. Moreover, investigating the intercategory issues in context of other categories of

converged/dedicated products is warranted for a greater generalizability to the current findings, which we leave for future research.

Figure 1

Technological Trajectories of Dedicated and Converged Products

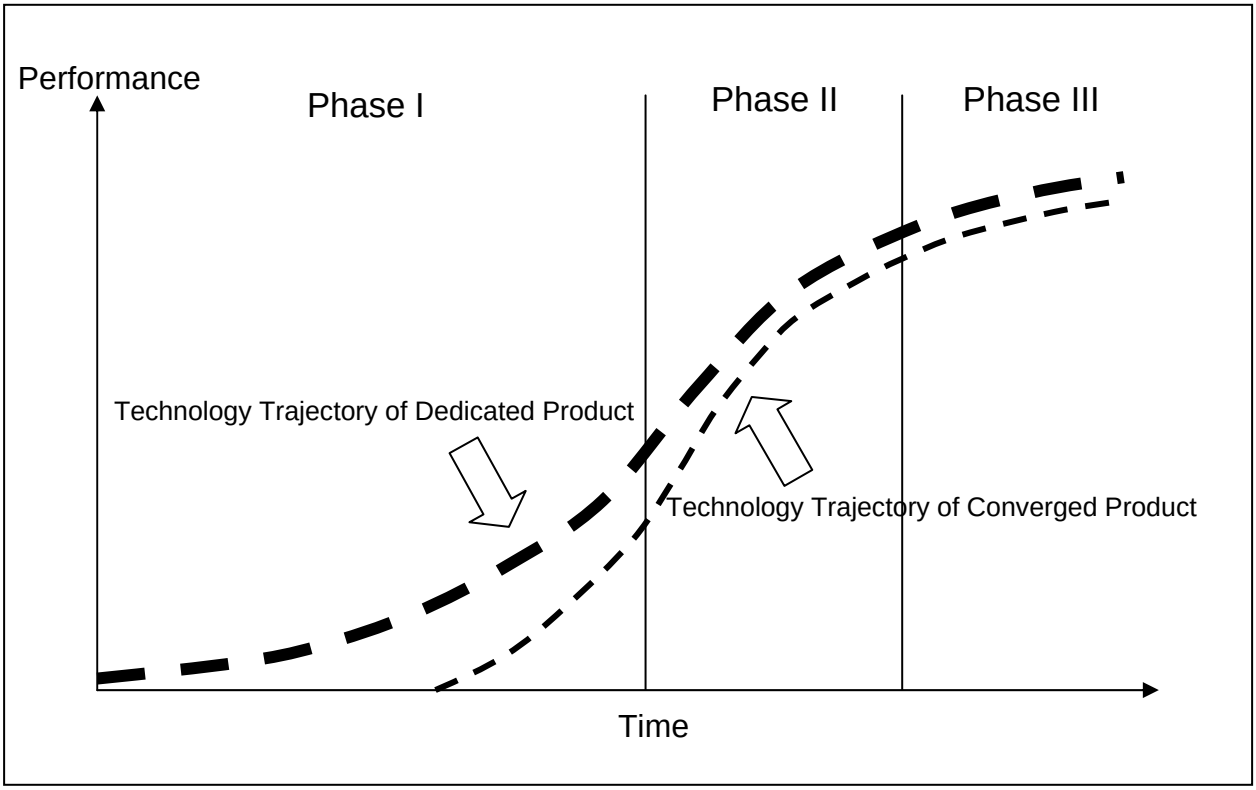


Figure 2

Substitutes and Complements

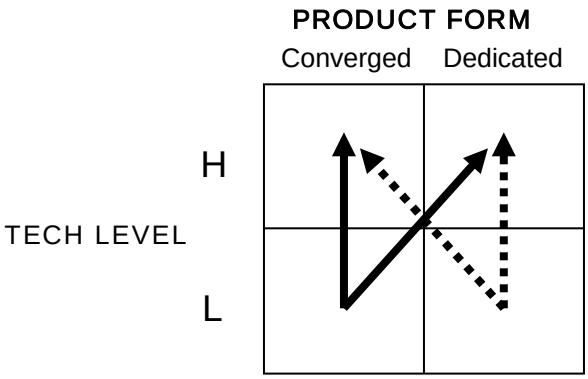


Figure 3

Consumer Preference for Product Forms

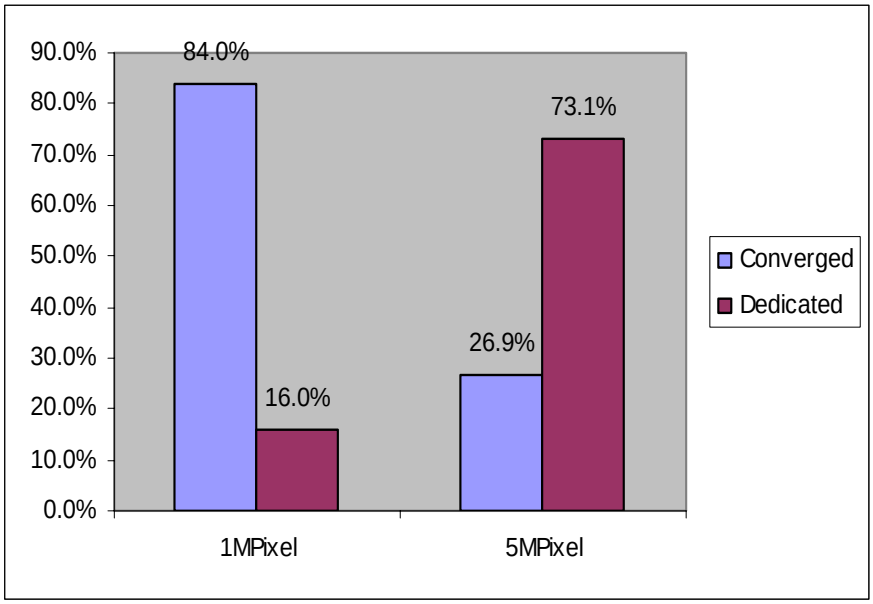
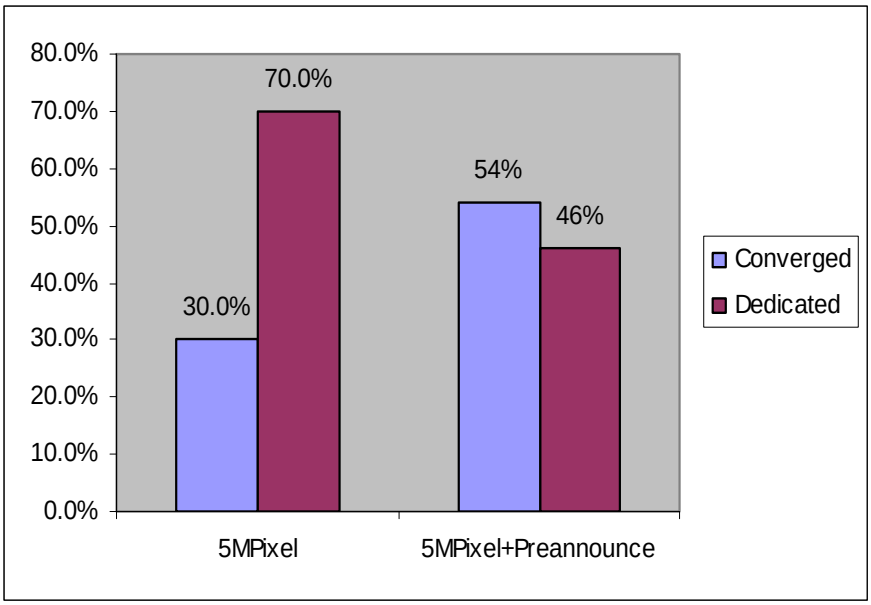


Figure 4

Consumer Preference for Product Forms: Preannouncement Effect



Appendix 1A

Sample Questionnaire (Low-performance Condition, Experiment 1)

Instructions: We are interested in learning about your preference on mobile phones, digital cameras, and camera phones. Please complete all the questions.

Note: Sample resolution of 1-megapixel image (actual picture sizes)

Imagine that you are considering the following package at the store. Assume that you presently do not own any of the following products:

Option 1: Price $400 (total price of two separate products)

- Mobile Phone ($300)
- Digital Camera with 1-megapixel ($100)

Option 2: Price $400

- Integrated Camera Phone
  - with 1-megapixel digital camera function

Which would you choose between Option 1 and Option 2? (please circle one):

1. **Option 1 (buying two separate products)**

   or

2. **Option 2 (buying one product with two features)**

Appendix 1B

Sample Questionnaire (High-performance Condition, Experiment 1)

Instructions: We are interested in learning about your preference on mobile phones, digital cameras, and camera phones. Please complete all the questions.

Note: Sample resolution of 5-megapixel image

Imagine that you are considering the following package at the store. Assume that you presently do not own any of the following products:

Option 1: Price $800 (total price of two separate products)

- Mobile Phone ($300)
- Digital Camera with 5-megapixel ($500)

Option 2: Price $800

- Integrated Camera Phone
  - with 5-megapixel digital camera function

Which would you choose between Option 1 and Option 2? (please circle one):

1. **Option 1 (buying two separate products)**

   or

2. **Option 2 (buying one product with two features)**

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